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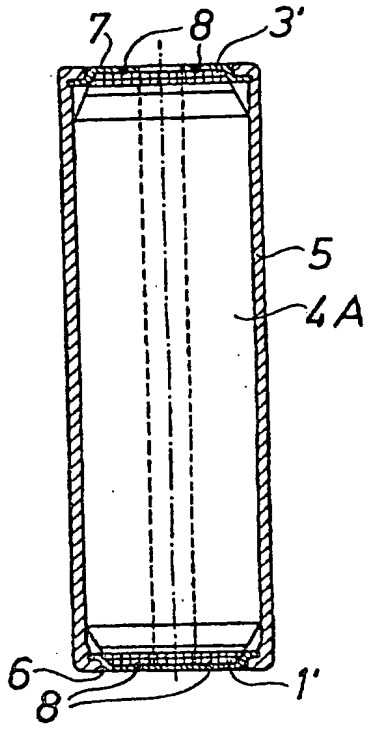
(54) Title: METHOD OF PROVIDING AN INTERNAL ELECTRICAL CONNECTION IN A SEALED BATTERY CELL

(57) Abstract

In a battery cell electrical connection between electrodes (1, 3) and electrically conducting end members (6, 7) of the cell container (5 - 7) is accomplished in that a battery coil (4A) consisting of wound electrodes and separators (2), wherein the electrodes have axially protruding, electrically conducting net edges (1', 3'), is placed in the cell container with the net edges in contact with the end members and in that welding joints are externally accomplished between the net edges and the end members.



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METHOD OF PROVIDING AN INTERNAL ELECTRICAL CONNECTION IN A SEALED BATTERY CELL

Technical Field

The present invention relates to a method of providing an electrical connection in a sealed battery cell between an electrode and an electrically conducting end member of the cell container. The invention also relates to a battery cell manufactured in this way.

Technical Background

At the manufacture of battery cells it is of great importance to accomplish the electrical connection between the internal electrodes of the cell and the externally accessible contact portions of the cell container, i e normally the bottom and the end cover, in the cheapest possible way and with asserted functional security.

A typical example of a prior technique for this purpose is shown in FR-A-2 356 284. Here, one of the electrodes in a battery coil directly contacts the cylindrical side wall of the metallic cell container, whereas the other electrode has protruding end edges, which downwardly rest against an electrically isolating bottom plate in the cell container and which upwardly directly or under assistance of contact plates contact the cover of the cell container. The uppwardly extending end edges can hereby be soldered to the cover or the contact plate.

The manufacture is comparatively expensive due to the relatively great number of working steps and related members, and the volume utilization in the cell container is far from optimal. Further, no guarantee for adequate contact can be given.

Other examples of previously known techniques are EP-A-029 925 and EP-A-413 867, where internal contact members

are welded to electrically conducting end portions of a battery coil before the insertion thereof in a conventional cell container. The contact members are in turn in contact with externally conducting portions of the cell container.

Also this technique suffers from the deficiencies mentioned above.

The Invention

For removing the drawbacks mentioned above with previously known techniques and for accomplishing an adequate and satisfactory electrical connection in the simpliest and cheapest way with best possible volume utilization the method according to the invention is characterized in

that an electrically conducting net edge is left at the application of electrode material on an electrode net for the production of a plate shaped electrode,

that the electrode - together with another electrode and separators - is wound into a battery coil with the net edge protruding from one end,

that the battery coil is placed in the cell container with the net edge in contact with the end member, and

that a welding joint between the end member and the net edge is externally accomplished.

Preferably line shaped welding joints are accomplished by laser welding, but any other conventional welding technique may also be utilized. Two such parallel welding joints can be accomplished.

If the cell container consists of a cylindrical tube of a plastic material and two electrically conducting end covers, the welding joints can preferably be concurrently accomplished in the two ends.

Electrolyte shall preferably be poured into the battery cell only after an accomplished welding operation, which is possible if the upper end cover has a center hole for a safety valve, which is mounted later.

The invention also relates to a battery cell manufactured in the above mentioned way. This battery cell can have the characteristics defined in claims 5 - 8.

The Drawings

The invention shall be further described below reference being made to the accompanying drawings, in which Fig 1 in a side view shows the different components of a battery coil before winding, Figs 2 and 3 in a side view and a top view, respectively, show a wound battery coil, Fig 4 is a side view of a battery coil after formation, Figs 5 - 7 in a longitudinal section, a top view and a bottom view, respectively, show a battery cell after a welding operation and Figs 8 and 9 are enlargements of the upper and lower portions, respectively, of Fig 5.

Detailed Description of a Preferred Embodiment

The starting material for an electrode coil for a battery cell according to the invention comprises, - as is shown in Fig 1 - a negative, plate shaped electrode 1, a separator 2, a positive, plate shaped electrode 3 and again a separator 2. In a nickel/metal hydride battery the positive electrode contains nickel material and the negative electrode a metal hydride.

The electrode material for the respective electrodes is rolled or pressed onto a metal thread net. As especially appears from Fig 1, an edge of the electrically conducting net material 1' and 3', respectively, protrudes from the negative electrode at its lower end and the positive electrode at its upper end. It will appear that these net edges form lugs or connections for the electrodes. At the manufacture of battery cells of type AA the total widths or heights in Fig 1 of the electrodes proper can be about 45 mm whereas the respective net edge can have a width of 1.5 mm. The electrode nets with the net edges can be manufactured of electrically conducting thread with a diameter of

about 0.2 mm. For obtaining a good mechanical stability the net edges 1' and 3' can be folded against themselves.

After winding, a battery coil 4 with an appearance according to Figs 2 and 3 will be formed, where the lower lug formed by the net edge 1' forms part of the negative electrode and the upper lug formed by the net edge 3' forms part of the positive electrode. At the winding a central, axial hole through the battery coil 4 is formed, as most clearly appears in Fig 3. The diameter of the coil can be about 12.5 mm and the diameter of the hole 3 mm.

In a following process step the ends of the battery coil are pressed to the oblique shape shown in Fig 4. The battery coil thus modified has the reference numeral 4A.

This modified battery coil 4A is arranged in a battery cell container, which is most clearly shown in Fig 5 and which consists of a mainly cylindrical tube 5 with two discs 6 and 7 closing the two ends. This battery container 5 - 7 is described in more detail in the international patent application PCT/SE95/01064 from the same applicant; reference is made to this application, but the following short description can be made in this context:

The cylindrical tube 5 is manufactured of a thermoplastic material, whereas the circular discs or covers 6 and 7 are manufactured of an electrically conducting plate material and are so melted or pressed into the tube 5 that a pressure tight sealing is accomplished. In a completed battery cell the upper cover 7 can be provided with a safety valve, which is described in the patent application mentioned above and in Figs 5 and 8 appears as a central hole. The outer diameter of the tube 5 can be 14 mm and its length 50.5 mm.

At the insertion of the battery coil 4A in the battery cell container the latter may already be provided with the bottom cover 6 and be upwardly open. After the insertion of the battery coil 4A the top cover 7 is placed or

pressed in position and is attached by melting, so that a battery cell container 5 - 7, which is closed with the exception of the safety valve, is accomplished. This completed container can have a length of about 49 mm. Due to the oblique formation of the ends of the battery coil 4 described above in connection with Fig 4 the battery coil will fill the cell container 5 - 7 well, so that a best possible capacity utilization is obtained.

After the insertion of the battery coil 4A in the upwardly open cell container and the sealing thereof by means of the upper cover 7 the net edges or net lugs 1' and 3' will contact their respective covers 6 and 7.

In order to accomplish the necessary, safe electrical contact between the net lugs 1' and 3' and the respective covers 6 and 7 a preferably line shape welding is made externally at the covers 6 and 7, so that the net lugs 1' and 3' are melted to the respective covers 6 and 7. In Figs 5 - 9 two such line shaped welding joints 8 are shown. The welding operations are preferably concurrently performed at the two ends of the battery cell.

The welding is preferably performed with laser technique, but other well known welding techniques are also possible. At the welding operation the cover material is in principle melted in lines, whereas the underlying net material is heated, so that the materials of the cover and the net are melted together in an electrically conducting and mechanically strong joint.

After the welding a suitable electrolyte is filled through the hole of the safety valve, whereupon the safety valve, which is not shown and described here, is mounted.

CLAIMS

1. A method of providing an electrical connection in a battery cell between an electrode (1, 3) and an electrically conducting end member (6, 7) of a cell container (5 - 7), c h a r a c t e r i z e d in

that an electrically conducting net edge (1', 3') is left at the application of electrode material on an electrode net for the production of a plate shaped electrode (1, 3),

that the electrode - together with another electrode and separators (2) - is wound into a battery coil (4A) with the net edge protruding from one end,

that the battery coil is placed in the cell container (5 - 7) with the net edge in contact with the end member (6, 7), and

that a welding joint between the end member and the net edge is externally accomplished.

2. A method according to claim 1, c h a r a c t e r i z e d in that line shaped welding joints (8) are accomplished by laser welding.

3. A method according to claim 1 or 2, the cell container (5 - 7) consisting of a cylindrical tube (5) of a plastic material and two electrically conducting end covers (6, 7), c h a r a c t e r i z e d in that the welding joints (8) are concurrently accomplished in the two ends.

4. A method according to any of the preceding claims, the end cover (7), having a center hole for a safety valve, c h a r a c t e r i z e d in that electrolyte is poured through the hole after welding but before the mounting of the safety valve.

5. A battery cell, including a cell container (5 - 7) with an electrically conducting end member (6, 7) and a battery coil (4A) therein comprising electrodes (1, 3) and separators (2) wound together, c h a r a c t e r i z e d in that an electrically conducting net edge (1', 3') axi-

ally protruding from an electrode (1, 3) in the battery coil (4A) is welded together with the end member (6, 7).

6. A battery cell according to claim 5, c h a r a c t e r i z e d in that the welding joint (8) accomplished between the net edge (1', 3') and the end member (6, 7) is line shaped.

7. A battery cell according to claim 6, c h a r a c t e r i z e d in that two welding joints (8) are accomplished between the net edge (1', 3') and the end member (6, 7).

8. A battery cell according to any of the claims 5 - 7, its cell container (5 - 7) consisting of a cylindrical tube (5) of a plastic material and two electrically conducting end covers (6, 7), c h a r a c t e r i z e d in that welding joints (8) are accomplished in both ends of the battery cell.

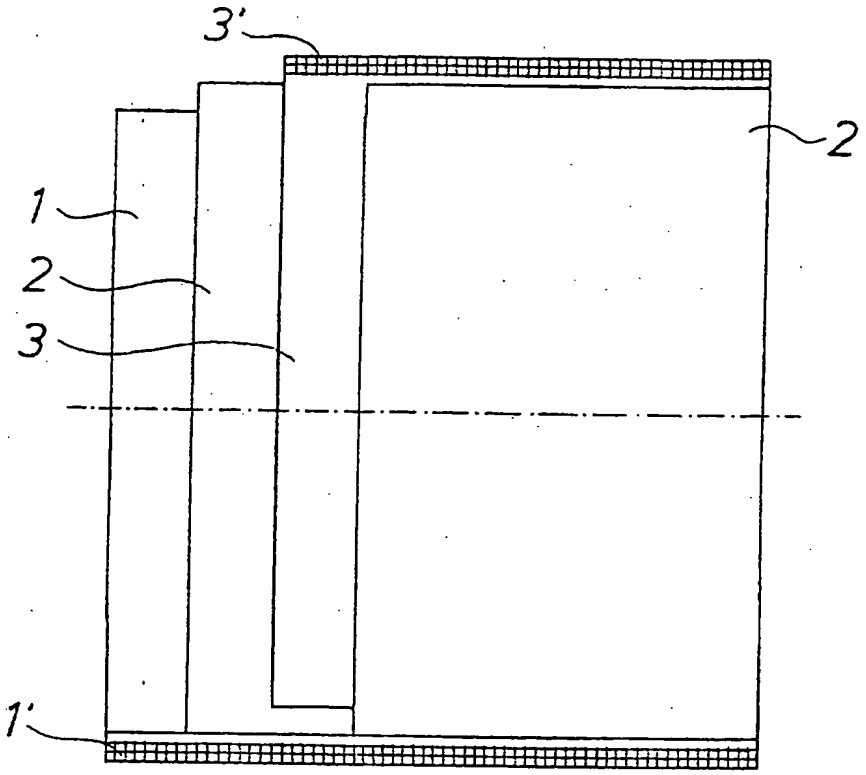

FIG. 1

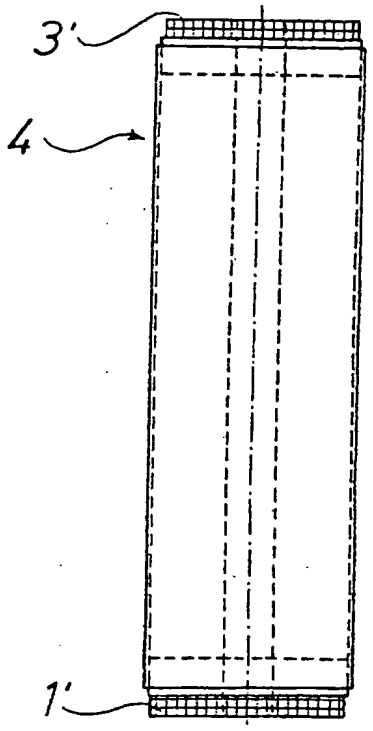

FIG. 2

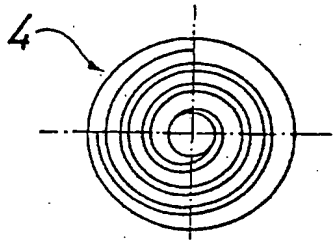

FIG. 3

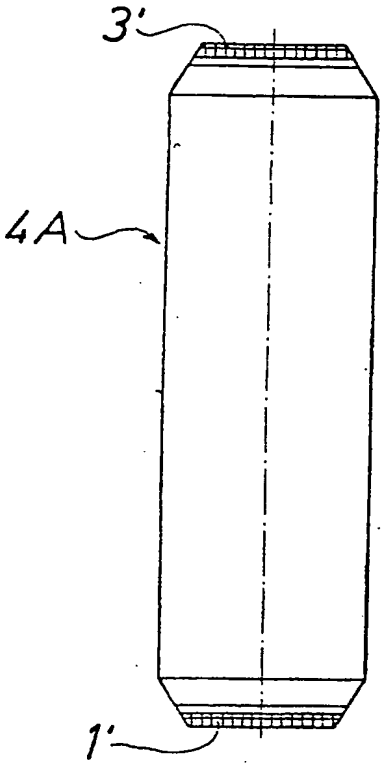

FIG. 4

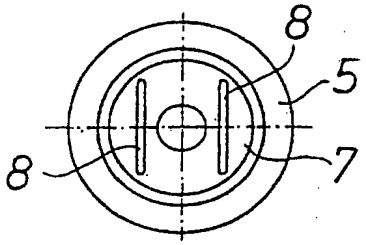

FIG. 6

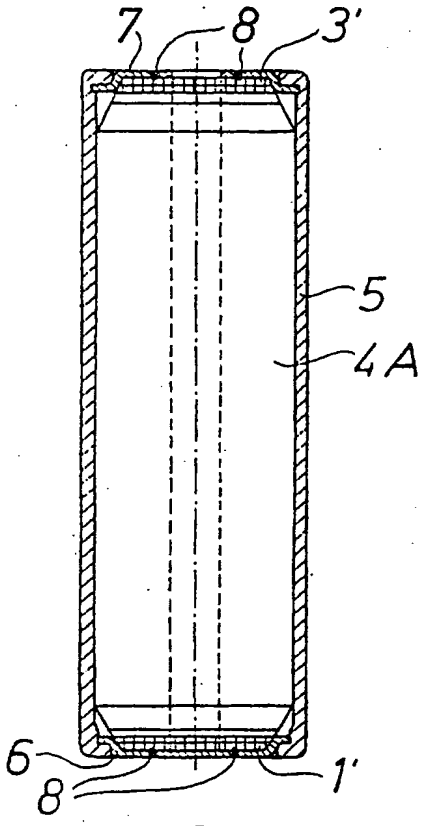

FIG. 5

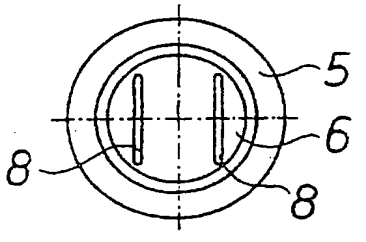

FIG. 7

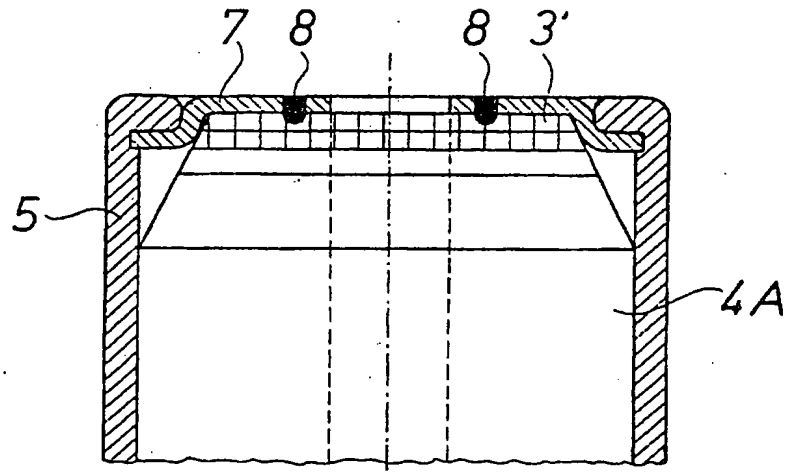

FIG. 8

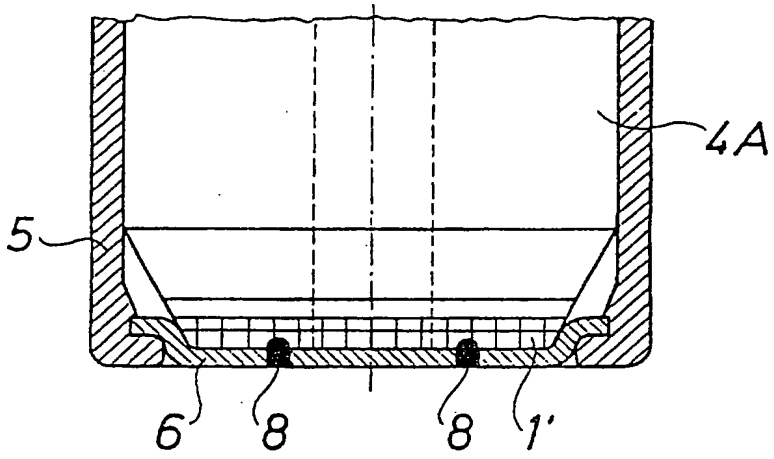

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/01453

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01M 2/22
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9101573 A1 (GATES ENERGY PRODUCTS, INC.), 7 February 1991 (07.02.91), page 8, line 36 - page 9, line 7 --	1,5
X	US 4053687 A (JEAN COIBION ET AL), 11 October 1977 (11.10.77), column 1, line 65 - column 2, line 6; column 3, line 15 - line 55, figure 1 --	1,5
A	Patent Abstracts of Japan, Vol 9,No 201, E-336, abstract of JP,A,60-65452 (SANYO DENKI K.K.), 15 April 1985 (15.04.85) --	1,2,5

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4902589 A (JEFFERY R. DAHN ET AL), 20 February 1990 (20.02.90), column 6, line 3 - line 30	1-10

INTERNATIONAL SEARCH REPORT
Information on patent family members

03/02/97

International application No.
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